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FACILITATORS AND BARRIERS OF IMPLEMENTING SEPSIS BUNDLES IN SEPTIC PATIENTS AT EMERGENCY AND CRITICAL CARE DEPARTMENT IN TIKUR ANBESA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA: A QUALITATIVE STUDY

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Acronym

CDC-centers for disease control and prevention

CFIR-Consolidated framework for implementation research

EPHI-Ethiopian public health institute

ESICM-European Society of Intensive Care Medicine

HIV-Human immunodeficiency virus

ICU-intensive care unit

LMICs-low and middle income countries

MEWS-Modified early warning score

NEWS-National early warning score

EPSA- Ethiopian pharmaceuticals supply agency

GRADE -Grading of Recommendations Assessment, Development and Evaluation

MOH-Ministry of health

qSOFA- quick sepsis related sequential organ failure assessment

SCCM-Society of Critical Care Medicine

SIRS-Systemic inflammatory response syndrome

SOFA-sequential organ failure assessment

SSC-surviving sepsis campaign

sSA - sub Saharan Africa

SDG-Sustainable Development Goals

TEWS-Triage early warning score

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Abstract

The main objective of the study is to explore the facilitators and barriers of implementing sepsis in septic patients at Emergency department in Tikur Anbessa Specalized Hospital, Addis Ababa, Ethiopia. It is supported by many studies that early diagnosis and treatment of sepsis by applying the sepsis bundles will improve the outcome of septic patients. Although this awareness is created among those practicing emergency medicine, it is not always optimally executed. In response, this qualitative study was designed to explore the facilitators and barriers of implementing sepsis bundles in septic patients at Emergency and Critical Care Department in Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia. The study was conducted from June to September 2024. A Consolidated Framework for Implementation Research was used to explore barriers and facilitators of implementing sepsis bundles in septic patients. The data was collected using in-depth and key-informant interviews with individuals who were selected based on their knowledge and experience in the matter. The data was coded and thematic analysis was done manually. The main results of the study were grouped into individual characteristics, inner setting, outer setting, process, and the intervention affect based on themes of the conceptual framework. The key facilitators include working in a university hospital which helps staff to access knowledge and skills, positive attitude for change by most of the staff ,attention being given to sepsis by the ministry of health (MOH) .The key barriers include resource limitation, lack of effective communication, gap in the involvement of key stakeholders, resistant behaviour of some staffs and lack of training and tools. In conclusion, although the research is done in a single centre, the results can contribute to quality improvement projects related to sepsis and lay a ground for future researchers.

Keywords: Emergency care, Evidence based medicine, Sepsis, Sepsis bundles, consolidated framework for implementation research (CFIR)

Introduction

1.1. Background

Sepsis is a dysregulated host response to infection resulting in a potentially fatal organ dysfunction. It is a complicated disease process which needs a rapid and coordinated response by multiple health professionals for better outcome of patients(3). The definition of sepsis has evolved due to better understanding of the condition over the years. In 1992 the first definition of sepsis was forwarded as systemic inflammatory response syndrome (SIRS). Severe sepsis was defined as sepsis with organ dysfunction, hypoperfusion, and hypotension; whereas septic shock is when the hypotension is not corrected with fluid. The second definition of sepsis forwarded in 2001 included clinical and laboratory results as part of the definition but still lacking specificity in identification of patients. The third definition was forwarded in 2016 where it is stated that sepsis is inappropriate host's immune response to infection leading to organ failure. This third definition also excluded the terms "SIRS" and "severe sepsis" from the definition of sepsis ; organ failure was considered based on the sequential organ failure assessment (SOFA)(2).

Surviving sepsis campaign (SSC) is an initiative started by a group of intensive care professionals to introduce guidelines based on researches that help clinicians to diagnose and manage sepsis. The first guideline was introduced in 2004 which was subsequently revised over the years 2008, 2012, 2016, 2018 and 2021. Sepsis bundle; which is an example of evidence based practice is a collection of different components which when implemented together result in a better outcome of sepsis patients(1). The first guideline included a 6 hour and 24 hour bundles which are clinical interventions that need to be implemented in the first 6 and 24 hours of patient arrival respectively. Through the course of improvement of the guidelines the time to initiate management has shortened progressively to the current 1 hour bundle approach based upon consideration of the emergent nature of sepsis and septic shock. In addition to that the recommendations were added based on the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach(2).

Even though there are major advancements in the understanding of pathophysiology and supportive treatment choices the death rate from sepsis and septic shock is still exceedingly high, as one in five people with sepsis are thought to pass away(2). It is suggested in the latest 2021

Surviving sepsis campaign (SSC) guidelines that hospitals and health systems should implement a sepsis performance improvement program, which includes standard operating procedures for treatment and sepsis screening for critically ill, high-risk patients (3). It is strongly recommended in this latest guideline that sepsis screening tools like qSOFA(quick sepsis related sequential organ failure assessment), NEWS (national early warning score), MEWS (modified early warning score) should be used to screen acutely ill and high risk patients for possibility of sepsis(2). It is understandable that most of sepsis related studies been done in high income nations and little is known about the uniformity of screening for sepsis for critically ill patients, the consistency of the use of standard operating procedures and the challenges faced by clinicians in implementing sepsis bundles in the real world in the setting of Ethiopian hospitals.

The research aims to identify the facilitating factors and the barriers of implementing sepsis bundles an Emergency and Critical Care Department at Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia. The study finding can contribute for designing strategies that facilitate early screening, appropriate management, quality care by proper implementation of the sepsis bundles and hence better outcome of patients.

The study will hopefully uncover the barriers and facilitators of sepsis bundle implementation using a qualitative approach by employing the consolidated framework for implementation research (CFIR) laying a ground for future researchers, quality improvement in sepsis management and inviting involvement of key stakeholders in the area and contributing to achieve the 2030 Sustainable Development Goals (SDG).

1.2. Statements of the problem

Severe organ dysfunction is the defining feature of sepsis, a potentially fatal and preventable condition. According to estimates, it affected 49 million people globally in 2017 and was linked to about 11 million potentially preventable deaths (4). Although the understanding of sepsis has advanced over the years since its first definition, the mortality rate is still very high (2). For severe infectious diseases such as bloodstream infections caused by bacteria, diarrheal illnesses, lower respiratory tract infections, malaria, dengue, and systemic fungal infections, sepsis is the last common path to death(4).

The latest surviving sepsis campaign recommends that sepsis should be recognized early and treatment should be started immediately which includes identifying and managing infection source, hemodynamic support, ventilation and other treatments (2). The majority of published research on sepsis treated in hospitals and intensive care units was conducted in affluent nations, with scant data from other regions of the world and it has high incidence and mortality especially in low and middle income countries (LMICs) (4).

Sepsis is public health emergency where an organized approach is needed by health care providers to recognize it early initiation of sepsis bundles which include source control, initiation of broad spectrum antibiotic, sending blood culture before antibiotic administration, volume resuscitation and others(2). In addition, focusing on management of sepsis is aligning with the United Nations Sustainable Development Goal (third goal) which is about good health and wellbeing. This study will hopefully contribute to quality improvement in sepsis diagnosis and management by trying to understand the root problems and hence the realization of the third Sustainable Development Goal.

The study was conducted in the Emergency and Critical Care Department at Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia using a qualitative approach in order to explore the facilitators as well as the barriers of implementing sepsis bundles.

1.3. Rationale of the study

Sepsis, is the last common pathway of invasive infections overwhelming the host defense and leading to death (5). The surviving sepsis campaign (SSC) which is a joint collaboration of Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM) updates its recommendations on sepsis care every four years and the recent 2021 update recommends sepsis performance improvement program is centered on the implementation of the sepsis bundles, the purpose of which is improving patient outcome (3). According to WHO, the mortality related to sepsis has various reasons which include low quality care, poor health care setting and infection prevention, delay in the diagnosis, inappropriate antimicrobial and other managements (6). Overall, the aim of this study is to understand the barriers and facilitators of implementation of sepsis bundles in the Emergency and Critical Care Department at Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia by using a qualitative study design, conducting in depth and key informant interviews, to uncover the real life experiences and

understandings of the responsible stakeholders for better improvement of one of the public health emergency that is sepsis in a resource limited setting like ours.

2. Literature Review

Sepsis contributes to 20% of all cause global deaths affecting population groups like neonates, pregnant, recently pregnant, and those living in low income countries (6). As many as one in four people die from sepsis and septic shock each year (3). Among the deaths recorded in the year 2017, 11 million was related to sepsis comprising 19.7% of the total death, where the underlying problem could be non-communicable disease, injury or infectious process(7). Accurate and prompt identification of sepsis is also dependent on the meaning of the condition (2).

Sepsis incident cases were estimated to be 48·9 million (95% UI 38·9–62·9) in 2017, and sepsis-related deaths were estimated to be 11·0 million (10·1–12·0). These estimates more than double previous global figures, most likely due to the addition of more data from middle-class and lower-class nations(7). Even in high-income nations where people have access to high-quality medical care, including critical care services, preventive care, and an effective vaccination program, sepsis remains a major cause of death. According to data from the US Department of Health and the Centers for Disease Control and Prevention (CDC), sepsis affects 1.76 million adults in the country and results in 260,000 fatalities each year(5). Fighting sepsis is an essential part of realizing Sustainable Development Goals(SDG) 3.1, 3.2,3.3(6). China has high prevalence of both ICU and hospital-wide sepsis(8). In Hong Kong, sepsis claimed the lives of 20% of hospitalized adult patients with suspected infections in 39% of cases(9).

In sub Saharan Africa(sSA) sepsis has poorer outcome compared to higher income countries due to lack of resources, concomitant HIV infection, delayed hospital presentation and process of care(10). In this region, the financial burden associated with neonatal sepsis ranges from $10 to $469 billion, but this burden could be reduced with effective treatment and prevention(11). Similarily in Malawi, sepsis is common in younger population with high mortality which is attributed to HIV, tuberculosis and malaria(12). A single center study in Ethiopia among pediatric sepsis patients showed that it is one of the main causes of death in the emergency department and it has a substantial effect on pediatric health and most patients has respiratory issues with majority of infections in their chests(13). Another single study done in Ethiopia showed that one of the main causes of death in the emergency department is sepsis. Although the epidemiology of adult sepsis is not well understood in the country, it is more common in men than in women most of which is caused by a respiratory infection(14). Sequential diagnosis and

prompt treatment of a sepsis patient preserves life. About one-third of sepsis survivors and their families continue to face significant challenges even after leaving the hospital. Following a critical illness, post-sepsis syndrome is becoming more widely acknowledged as a significant factor in poor long-term health(5).

Evidence based medicine is solving of a clinical problem by application of best available research evidence, patient preference and clinical expertise(15). The term "usual care" refers to the standard operating procedures for sepsis, which were originally defined as Early Goal Directed Therapy. This includes early identification, lactate, cultures, antibiotics, fluids, and other elements of the sepsis bundle (3). Small collections of evidence-based suggestions called "care bundles" are intended to assist in the application of optimal clinical practices based on evidence(15). SEP-1(sepsis-1) implementation is associated with increased serum lactate measurement and use of broad spectrum antibiotics(16). Sepsis bundles are essential components of care for the diagnosis and management of patients experiencing septic shock. They facilitate the translation of intricate protocols into significant behavioral modifications(17). Hospitals that have successfully implemented these bundles have consistently shown improved outcomes and reductions in healthcare spending(18).

The sepsis guideline now strongly advise using tools and programs such as qSOFA(quick sepsis related sequential organ failure assessment), National Early Warning Score (NEWS), and Modified Early Warning Score (MEWS) to enhance care, including identification in the populations of high-risk and acutely sick patients(2). qSOFA (quick sepsis related sequential organ failure assessment) and SIRS (systemic inflammatory response syndrome) are very sensitive sepsis screening tools which can be used in conjunction to enhance sepsis identification(19). Compliance by itself, without taking into account the time to diagnosis of sepsis, is unlikely to reduce mortality in environments where late recognition is common (20). In other words even if there is adherence to the targets of the guideline, inability to detect sepsis itself early and a delay in the ICU admission affects the outcome of patients negatively(21). To mention another significant obstacle to implementation is the variation in the extent to which guidelines enable the conversion of their recommendations into action(22). On top of that, lack of committed personnel, resources, medical and nursing staff , adherence to fundamental standards of high-quality care can be raised (20). Moreover communication gaps and poor team

work can be mentioned as a barrier (23). Inadequate number of surgical staff can contribute to poor outcome of patients because of difficulty of timely source control especially in low and middle income countries(24). Implementation of any bundle depends on alterations in the culture of an organization like behavioral and attitude change amongst the staffs, forums on patient safety and learning from neglects (25). In addition Individualized sepsis management strategies rather than uniform application of the sepsis should be done for better results (26). It is not enough to introduce bundles and expect for its operation unless there is measurement of the adherence to it (15). Improvements in performance, such as modifications to educational procedures, lead to a rise in adherence to SSC guideline bundles(19). Similarly a multidimensional approach to management of sepsis leads to increased perception and adherence to sepsis bundles (20). In addition simple tools like posters, reminder cards, flow charts, pre-defined order sets, checklists, electronic clinical decision support tools, regular auditing of the managed cases and feedback mechanism with availability of "sepsis team" leads to better diagnosis and management of these patients (21). When it comes to spotting changes in physiological observations that might point to the beginning of sepsis, nurses are essential (27). Early engagement by senior physicians improved compliance rate and is essential to the management of sepsis because their greater experience enables more prompt decision-making, maximizing the amount of time available to initiate management (28). Moreover quality improvement projects consisting of standardized quality measurements, documentation and order entry can lead to abidance to health quality initiatives for implementation of the bundle (29). Literatures support that sepsis guidelines should be adapted in low and middle income countries (LMICs) according to the local setting resources (30). To enhance clinical coding and record keeping, healthcare facilities should establish quality assurance teams (31).

3. Conceptual framework

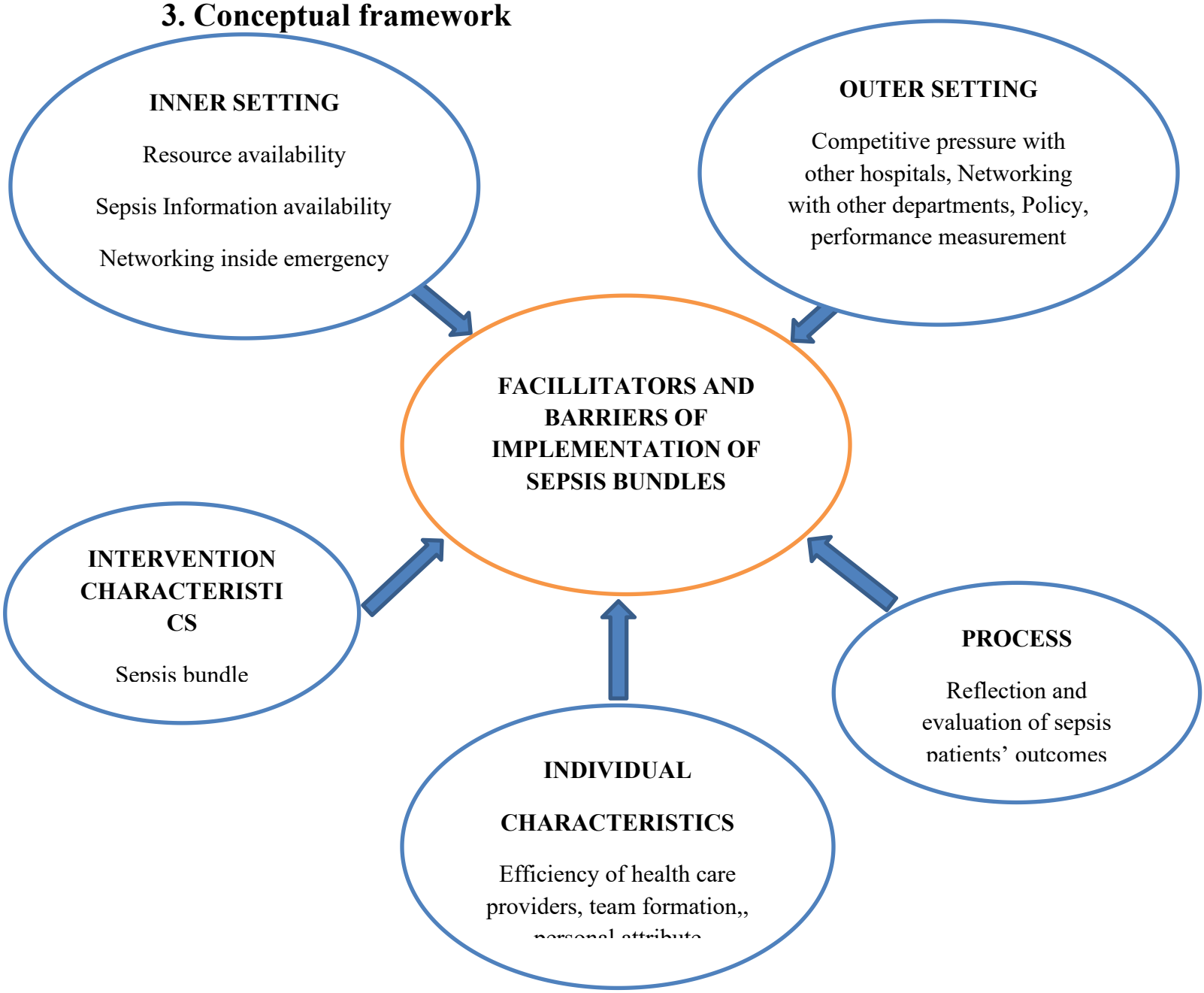

Figure 1 Conceptual framework of the study-Consolidated Framework for Implementation research(CFIR)(32)

4. Objective of the study

4.1. General objective

- To explore the facilitators and barriers of implementing sepsis bundles in septic patients at the Emergency and Critical Care Department in Tikur Anbesa Specialized Tertiary Hospital, Addis Ababa, Ethiopia using The Consolidated Framework for Implementation Research (CFIR) which includes inner setting, outer setting, individuals, process and intervention.

4.2. Specific objectives

- To explore facilitators of implementing sepsis bundles in septic patients at the Emergency and Critical Care Department in Tikur Anbesa Specialized Tertiary Hospital, Addis Ababa, Ethiopia using The Consolidated Framework for Implementation Research (CFIR) which includes inner setting, outer setting, individuals, process and intervention.

- To identify barriers of implementing sepsis bundles in septic patients at the Emergency and Critical Care Department in Tikur Anbesa Specialized Tertiary Hospital, Addis Ababa, Ethiopia using The Consolidated Framework for Implementation Research (CFIR) which includes inner setting, outer setting, individuals, process and intervention.

5. Methods and materials

5.1. Study design and period

A phenomenological qualitative study design was employed to explore the barriers and facilitators of implementing sepsis bundles on septic patients in the emergency department of a government teaching hospital. The study was conducted from June to September 2024.

5.2. Study setting

The study was conducted at Emergency and Critical Care Department in Tikur Anbesa specialized Tertiary Hospital, Addis Ababa, Ethiopia**.**

5.2.1. Implementation research framework

A consolidated framework for implementation research (CFIR) was used. The CFIR consists of five domains which include inner setting, outer setting, intervention, individuals and process(32).

5.3. Source population

Healthcare workers working in the Emergency and Critical Care Department in Tikur Anbesa Specialized Tertiary Hospital and Ministry of health (MOH).

5.4. Study population and sampling procedure

Ten individuals were selected based on a purposive sampling from residents, nurse coordinators, staff nurses, flow manager nurse, clinical service director, emergency pharmacy personnel, laboratory personnel ministry of health (MOH) working in the emergency department of Tikur Anbessa Specialized Hospital, Addis Ababa. A purposive sampling technique was used to identify the interviewees based on their experience, their level of engagement and role in the emergency related to sepsis management. A qualitative approach was used and semi-structured face-to-face interviews were conducted. Data was collected by the principal investigator. Data saturation was reached after conducting ten interviews as interview information became repetitive. The interview was then transcribed and coded. Themes were generated, and defined; and finally thematic analysis was done manually.

5.5. Data collection methods and procedures

The information or data were collected from stakeholders that had connections with the management of sepsis. . Healthcare workers would try to justify their poor performance, if any, by explaining the challenges they faced and how they tried to overcome them. Furthermore this is mainly related to their lived experience with the barriers and facilitators of implementing sepsis bundles to improve the outcome of sepsis patients. The research was conducted with Amharic language by the principal investigator which was then translated to english before it was transcribed. The questions were framed as per the Consolidated Framework for Implementation Research (CFIR) components: outer setting, inner setting, individual characteristics, intervention characteristic and the process implementation (Table 1).

Table 1 Consolidated framework for implementation research (CFIR) on barriers and facilitators of implementing sepsis bundles among septic patients at Emergency and Critical Care Department, Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia, 2024.

Table 1 Consolidated Framework for Implementation Research on facilitators and barriers of implementing sepsis bundles at the emergency.

Intervention characteristic	**Inner setting**	**Outer setting**	**Process**	**Individual characteristic**
Intervention complexity	Resource availability Information availability for managing sepsis Networking inside emergency	Competitive pressure with other institutions Policy or direction from the government Networking between emergency and other department Performance measurement Financing	Reflection and evaluation of sepsis bundle implementation	Efficiency of emergency care providers Team Personal attributes

5.6. Data quality assurance

To significantly enhance the study's credibility, members of emergency department of the hospital who have direct involvement in the management of sepsis were recruited. Their active participation in the research and sharing of their experiences in sepsis management were paramount. Appropriate locations were selected by the data collectors to conduct the interviews, where participants would feel comfortable to respond openly. Additionally, efforts were made to explain the purpose of the study in order to maintain the participants' trust in its importance, thus ensuring that they could provide open, thorough, and honest responses.

5.7. Data processing and analysis

The qualitative data analysis began concurrently with the data collection process, with additional probing questions being asked based on the participants' responses. Verbatim transcription and translation to English were carried out. The translated data were coded, and emerging themes were grouped using the components of the CFIR framework then thematic analysis was done manually. The five original CFIR domains were used to categorize findings but the sub domains were modified to fit into the specific research. The interview revealed that the facilitators as well as the barriers to implementing sepsis bundles revolve around five major categorizations which are inner setting, outer setting, intervention characteristic, individual characteristic and process which is based on the components of CFIR(Consolidated Framework for Implementation Research). Each of the CFIR components was subdivided in to sub domains except for intervention characteristic and process which was meant as complexity of the intervention and reflection and evaluation of sepsis bundle component respectively. The inner setting included resource and information availability, and networking inside the emergency. The outer setting includes competitive pressure with other institutions, policy or direction from the government, networking outside of the emergency setting, performance improvement initiatives as well as measures, and finance. Individual characteristic includes efficiency of emergency health care providers, team spirit and personal attributes. The CFIR components for the study are listed in Table 1.

5.8. Ethics approval and consent to participate

The study obtained an ethical clearance from Ethical Committee of the Department of Emergency Medicine and Critical Care, School of Medicine, Addis Ababa University (Ref. No/MS/97/2028).

6. Results

6.1. Description of the study participants

In the study a total of 10 interviews (pharmacy personnel, laboratory personnel, emergency clinical service director, residents, staff nurses, coordinator nurse, head of Services Desk in medical service lead executive office at Ministry of Health) were interviewed face to face which lasted from minimum of an hour and maximum of one hour and 30 minutes to explore the facilitators and barriers of implementing sepsis bundles in the emergency setting (Table 2).

Table 2 The participants work experience

Participant's description	**Response**	**Frequency**	**Percentage**
Sex	Female Male	3 7	30% 70%
Educational status	Resident First Degree Master's Degree Specialized doctor	2 2 5 1	20% 20% 50% 10%
Work experience	<5 year >5 year	5 5 50%	50%

6.2. Barriers and facilitators to implementing sepsis bundles in the emergency

The sepsis bundles are a set of procedures forwarded by the surviving sepsis campaign for better management of sepsis patients and hence their outcome. Although sepsis bundles are accepted by health care providers and are applied on septic patients, in reality the implementation of sepsis bundles is affected by different factors which is the particular interest of this study to uncover. For this study different participants were included in the interview who is working in relation to sepsis in one or in another way. The answers of the participants is coded manually and thermalized in five major domains which is in accordance with the five domains of the consolidated framework for implementation research (CFIR). Some of the domains are complex so they are divided into categories to present the clear idea of the participants.

Intervention characteristic

Complexity of the intervention

Sepsis management is a set of procedures and not just a single intervention. It is a management as agreed by all participants should be implemented in an aggressive manner immediately after identifying suspected sepsis patients. Since sepsis is associated with high mortality the management should also be organized enough as mentioned by one participant as

"Health care providers like clinicians, laboratory personnel and pharmacists should collaborate in order to manage sepsis patients" (code ID 1).

Another participant mentioned that

"overall it's about acting fast in order to improve patient outcome" (code KI 1).

A third participant stated

"intervention for sepsis starts by differentiating patients at the triage with collaborative response from emergency residents and nurses requiring samples to be taken to laboratory and medication to be administered from the pharmacy(code ID 2)"

so it makes the intervention more complex as all sepsis screening tools cannot be used because of urgency of the problem but rather it depends on high index of suspicion although it may not be sepsis in case of some patients.

Inner setting

Resource availability

There is no doubt that sepsis bundle initiation requires an adequate resource with in the emergency. The main challenge mentioned by most participants is lack of every resource when needed. As one participant mentioned

"golden hour may pass before broad spectrum antibiotic is started and the patients may deteriorate even more (code ID 5)."

Other participant also mentioned

"we may not get the antibiotics, vasopressors of choice, vital sign measurement tools and sometimes gloves, syringes and cannulas may not be available timely (code ID 4)". Sending blood culture before antibiotic initiation is not possible in many scenarios as the culture bottles are

not available at bed side and by the time the culture bottles are brought by the families, antibiotics may have already been started which is not in accordance with the recommendation from the surviving sepsis campaign. On top of that, crash cart is not adequate and it is not properly filled because there is no single person properly assigned to monitor the crash cart. There is continuous supply of necessary drugs from the central pharmacy to emergency dispensary which is enough for four weeks based on calculations made and on top of that if there is any urgent need of materials it can still be requested from the central pharmacy. The pharmacy tries at its best to deliver materials to septic patients who not only afford to buy or are health insurance covered but also for patients who do not have both advantages. As a participant mentioned

"There're four methods of Payment to the pharmacy in the hospital which are payment out of the pocket, health insurance system, third party system for patients unable to pay in the first 24 hours, and the social work system (code ID 3) ",

so by using one of the four methods of payment; the cost for the treatment of a patient is covered. Despite all this, the budget allocated may not still be adequate for the expensive broad spectrum antibiotics required by septic patients and hence patients get only some of the treatments from the pharmacy in the hospital compound. The resources available may not be the first line choices based on the recommendations is another point raised by one participant

"vasopressor of choice like noradrenaline is not available at this hospital and even after starting them initially we may be forced to discontinue or change to another vasopressor because patients may not get them from the pharmacy in the compound (code ID 5)".

The laboratory always accepts samples and never discards them. The team is also very confident on the materials they have at hand

"we have adequate resources in carrying out our daily activities like medias, antibiotics for sensitivity and culture broth (code ID 6)".

Although the mentioned materials are available the laboratory , it still uses the conventional culturing method and it lacks the advanced method for culture detection which could have increased detection of microorganisms and requires shorter time of processing the sample. On top of that, the blood culture bottles are also made of glass which are re-usable and hence may get lost

and broken. The other important sepsis bundle component that is serum lactate determination is not available as there's no arterial blood gas determination and there is also no perfuser to strictly follow the vasopressor infusion.

The other major problem mentioned by participants is regarding the human resource. As one participant mentioned

"…not only material shortage is there but also human power is not enough in the emergency (code ID 4)".

Similarily; unavailability of phlebotomists at the emergency has led nurses and physicians who are engaged in many responsibilities to spend time in drawing blood culture sample from patients.

The triaging system as seen by the participants has still some gaps like properly posting or using other advanced techniques for fast triaging septic patients as the management starts by identifying the patients in the first place. One participant mentioned

"in our set up we have assigned residents from year 2 and 3(more senior year residents) in addition to the nurses to thoroughly identify septic patients at the emergency and on top of this we have also trained nurses on triaging few times but the applicability is different by different persons (code KI 1)".

Information availability for managing sepsis

Most participants agreed that there is no written material or a soft copy for reference in the emergency**.**

"As much as the hospital is a teaching hospital and there're students like interns and residents who have frequent rotations; there should be a materials on sepsis posted everywhere (code ID 1) " is forwarded by one participant.

Another participant mentioned

" There's a large sepsis bundle algorithm posted at the yellow side of the waiting area although I cannot be sure that how many people are able to refer to it. There are no printed out references but there's a class teaching and seminar on sepsis for the residents and most people tend to refer to

materials using their phone. A telegram group is also created where guidelines can be posted (code KI 1)".

Another participant mentioned that

"…there was one sepsis symposium recently prepared by the infectious disease department at the hospital which gave us insight on some sepsis updates (code ID 8)"

Network and communication inside the emergency

Some of the participants believe that there is a poor communication among health care providers inside the emergency especially outside of the red zone**.** As mentioned by one participant "Sometimes the nurses may not know that a drug has been ordered and there's an atmosphere in the emergency that creates a sense of hierarchy which leads us to think in way that some physicians act like a boss to order nurses (code ID 4)".

Outer setting

Competitive pressure with other institutions

All participants acknowledged that there's no platform prepared for comparison of the performance of the hospital regarding sepsis patients. As a participant mentioned

"I can say that there's no specific work done about sepsis but, we are currently being driven by the urgency of the sepsis itself (code KI 1)".

Some even mentioned what they observed informally from other hospitals could benefit if it's adapted here. One participant mentioned

"from my observation I saw in one hospital that whenever a patient shows signs of sepsis, a team prepared for this will start to evaluate them. They review the chart of these patients and try to assess what is going on in the patients and act accordingly (code ID 1)".

Team work will help save time to diagnose and intervene timely. Other participant mentioned that

"from what I hear informally there're other government hospitals with a setting capable of giving a better service than ours because they have no resource scarcity (code ID 8)".

"Engaging with other institutions to share best practice, learning from their experiences and using competition as motivation to continuously improve sepsis (code KI 2)" was mentioned by other participant.

There are exemplary hospitals with good performance who are working to reduce irrational use of antibiotics by allowing only the most senior physicians to order broad spectrum antibiotics who are able to take responsibility.

Policy or direction from the government

All participants agreed that currently there's no direction or policy from the government up to now regarding sepsis but as one participant mentioned

"guideline preparation for sepsis is currently under development at the Ministry of Health (code KI 2).

One participant also mentioned that

"we have a direction from the ministry of health about ventilator associated pneumonia and surgical site infections but we do not have a guideline on sepsis (code KI 1)".

Although the burden of sepsis is huge, there has been no adequate training prepared for the staff.

Networking between the emergency and other department

The networking with departments outside of the emergency is still inadequate. These include the laboratory, pharmacy, hospital administration. The laboratory and pharmacy staffs believe that there is good networking among themselves. As a participant mentioned

"The communication among the microbiology staff is very good as a whole but this need to extend to involve other emergency health care staff too" (code ID 6).

Similarly the communication with pharmacy is also limited. This is not the same always the case and as one participant reflected a different idea,

"we have good communication with other departments like the ICU whenever we want to dispose our patients there and the problem comes because of lack of bed from their side" (code ID 7).

Performance measurement

The emergency has no clear performance measure specific for sepsis management. On the other hand, the laboratory, despite its resource limitations, is performing to the best of its ability. This is reflected by the laboratory's quality assessment results at the national level by the EPHI (Ethiopian Public Health Institute) as well as internationally there times per year by 'One World

Accuracy' in collaboration with the EPHI (Ethiopian Public Health Institute) for the quality of their work.

Financing

The inadequate budgeting is reflected by some participants like

"There is inadequate budgeting and allocation of resources where the result is obviously seen in the shortage of necessary materials and drugs needed in managing sepsis (code ID 3)".

Process

Reflection and evaluation

All participants agreed that there is no specific evaluation of the outcome of septic patients in the emergency but rather there's a monthly audit where there's discussion on what happened in the past month which includes septic patients as well. As one participant mentioned

"The current approach should be modified so there will be a clear direction of the future improvements we should make on sepsis (code ID 2)".

Individual characteristics

Efficacy of emergency health care providers

The efficiency of emergency health care providers is individualized as most participants agreed but generally the residents are mentioned as knowledgeable about sepsis management. One participant mentioned that

"I do not think that there is a gap in knowledge as well as skill among the emergency care providers as it is a teaching hospital" (code ID 1).

A knowledge gap is noticed in the proper handling of infectious waste by the cleaners and it was forwarded that those staff need proper training. Other participants mentioned that there's a knowledge gap among some of the nurses as they are not involved in the academic activities.

Team formation

There is no formal team formed specifically for accepting septic patients. There are gaps that still need to be filled in the emergency, yet the emergency has improved the management of sepsis patients over the years as compared to other departments. As one participant mentioned

"Overall the response to sepsis diagnosis and management is good at the emergency when compared to other departments in the hospital; patients can be sent to the emergency after sepsis

is diagnosed from outpatient departments without even securing IV cannula or being accompanied by a health care provider (code KI 1)".

Personal attributes

One of the problems that were partly responsible for inadequate implementation of the sepsis bundles to the ground in the emergency is resistant attitude to change by some of the care providers. Some care providers may not want to apply what they know like sending sample for culture before they initiate antibiotics even if they know and are able to do it.

"The attitude problem can be inherent but sometimes it is linked to the discouragement of health care providers because of inadequate resources in the emergency setting (code ID 8)" mentioned one of the participants.

The other problem mentioned by participants is that some emergency staff members may not handle the available properties properly and this adds to material shortages already existing at the emergency.

"Everyone should keep the materials in the emergency as their own so we can use it for long (code ID 2)"

mentioned one participant .On the other hand some physicians do not return the culture bottles they brought from the laboratory responsibly due to different reasons.Additionally attitudes of some physicians in the use of broad spectrum antibiotics by before properly using the tools to identify septic patients and hence labeling them as 'septic' leads to unnecessary use of antimicrobials. This is concerning as the sepsis itself as all patients diagnosed as septic may not be septic after all. One participant even mentioned that

"we tend to over diagnose sepsis (code ID 8)".

Another participant also mentioned

"My concern about sepsis management is that we have currently reached to a state that we are using broad spectrum antibiotics immediately and in the future we are at great risk of losing the battle of antibiotic resistance" (code KI 1).

7. Discussion

The application of sepsis bundles is challenged by different factors in the emergency department of Tikur Anbessa Specialized Hospital. These mainly include absence or shortage of the necessary resources, not applying sepsis screening tools for critical patients, inadequate human power, poor networking among the service providers, lack of an organized system to manage septic patients, lack of proper performance evaluation of outcome of septic patients, no platforms to have experience sharing with other hospitals who perform well regarding sepsis, inadequate communication outside of the emergency whenever there is a need to, unavailability of written or electronic materials regarding sepsis in the emergency. As there are barriers to implementation of sepsis bundles; there are also facilitators like being a teaching hospital which leads to easy access to knowledge and skills, a tendency of positive change shown by the emergency personnel to improve sepsis performance and sepsis guideline being prepared by the Ministry of Health, which is an indicator of government's officials interest on sepsis, enthusiasm shown by some health providers in making informal observation of other hospitals on their good sepsis management activities.

A qualitative research design was used to explore the barriers and facilitators of implementing sepsis bundles in the emergency department. The participants were selected using purposive method considering that they will represent the groups of interest. An in-depth and key informant face to face interview was carried out in 'Amharic language' which every interviewee is able to speak fluently. The participants were interviewed over a course of three weeks based on their convenient time and place where they can freely give their interviews. All participants got reassurance that their interview record is kept confidential and their identity will not be revealed before the start of the interview. Data collection was finalized as theoretical saturation was reached after ten interviews. The interview was recorded, translated and transcribed before it was coded. The codes were grouped under themes based on the theoretical framework which is consolidated framework for implementation research (CFIR). During the analysis step, iterative process of data revision was done to avoid missing important ideas raised by the participants.

Sepsis improvement initiatives like posting algorithms and antibiograms at the emergency, symposium for sepsis, telegram groups for posting different guideline were done in the past which are inconsistent but have contributed for improvement of sepsis management over the

years. The fact that it is a teaching hospital supports care providers to acquire knowledge and improve their skill on sepsis over the course of time. In support to this, hospital quality initiatives like improving the process of ordering and documentation on the electronic medical recording resulted in a better compliance to bundles(29). In other word Performance improvement strategies are linked to better compliance to sepsis bundles(17). Consequently, better patient outcomes are linked to performance improvement initiatives(3),(21). Measuring compliance to sepsis bundles is crucial to bundle implementation(15). In addition education and training, predefined order set, clinical decision aids, activating sepsis response teams improve the bundle compliance(21).

Sending culture sample before antibiotic is important for several reasons which include better diagnosis of causative agents, proper management and decreasing the risk of antimicrobial resistance. The challenges in Tikur Anbessa Hospital with respect to this include; unavailability of sample bottles right away, lack of phlebotomists, inadequate number of staff, and sometimes reluctance of some health providers. There should be every effort to send culture samples for sepsis and septic shock patients before the antimicrobials are initiated as long as it doesn't delay antimicrobial initiation(3).

Patients need to be identified clearly since all patients with fever or infection are not septic and starting broad spectrum antibiotics can lead to excessive cost and unnecessary use of antimicrobials(5). Those who fulfill the criteria of systemic inflammatory response syndrome(SIRS) ;which is one of the tools together with others to identify sepsis patients may not be present in septic patients and it can also occur in other non-septic illnesses(33). This leads to unnecessary use of antibiotics contributing to microbial drug resistance, financial burden to the patients and prolonged stay. In one study it showed that identification of sepsis patients early has been associated with improved patient survival(20).

One of the main challenges in implementation of sepsis bundles at the emergency is lack of the necessary resources. This is true as the hospital is found in resource limited setting. Similarly inadequate resource is a challenge in other public hospitals in Brazil (20). Against to this; studies in implementation of bundles in the ICU setting showed the main factors associated with bundle compliance were organizational culture, auditing, monitoring the compliance(25). Nordrenaline is the vasopressor of choice in the management of septic shock(2) but in the Tikur Anbessa

emergency pharmacy there's still a difficulty in getting noradrenaline but rather patients go outside of the hospital in search for it which is also very expensive so most of the time adrenaline which is a second vasopressor of choice is used to treat patients in shock. Because of this sometimes there is difficulty of completing the started antibiotics and also continuing vasopressors. This has its own consequences like delay in some of the interventions that need to be initiated early, patients and families' exhaustion and discouragement due to paying extra money at private pharmacies and in some cases families of patients may discontinue bringing medications because they finish the money they have at their hand while buying expensive medications.

The other challenge faced is lack of adequate number of blood culture bottles at the laboratory which are made of glass and prone to breakage, this led to initiation of antibiotics before the culture samples of blood are taken which is against the recommendation of surviving sepsis campaign(SSC)(3). The laboratory cannot provide the modern (advanced) techniques of culture processing but rather uses the conventional method despite the high volume of samples it receives daily. This resulted in delay in the time to reveal the culture results in addition to missing some positive results. Clinical decision support interventions help remind health care providers send culture before ordering the first dose of antibiotics(34). Another important sepsis bundle component which is determination serum lactate is not available at the Tikur Anbessa emergency. Serum lactate is a surrogate for tissue perfusion which is helpful in monitoring the perfusion status of patients as part of sepsis bundle(3).

The pharmacy has its own limitations like inadequate budgeting to avail all necessary materials. In addition the supply from EPSA (Ethiopian pharmaceutical supply agency) is not meeting all the demand of patients. Despite this challenge the pharmacy is trying to serve patients with a continuous supply from the central pharmacy to the emergency pharmacy. For example for patients to get service from the pharmacy there has been created four means of coverage of their expenses; this includes the direct payment out of pocket, thorough the health insurance system, via a third party system for those patients who cannot pay in the first 24 hours and finally via social service means. This shows that there's an effort to help patients as much as possible by using one of the four methods so they will not miss their treatments; yet this system is sometimes overwhelmed by the high burden of patients and hence the supply may be interrupted.

Inadequate human power is another factor associated with inadequate implementation sepsis bundles in the emergency. Inadequate human power is more prominent outside of the red zone of the emergency where one to one patient ratio is there. This problem results in delayed initiation of management because of high patient burden as patients need to wait until they are properly evaluated and management is initiated by physicians. The part of the emergency outside the red zone was considered as a challenging area because it is very hectic and staff number is not proportional to the patient numbers. Having this atmosphere leads the nurses to be reluctant in what the physicians say and hence can affect the management of sepsis patients. The other issue is unavailability of phlebotomists at the emergency which burdens the limited number of physicians and nurses there and because of this culture samples may not be taken properly based on the standard. Similarly a study in a Brazilian public hospital showed that inadequate human power is one of the challenges to implement sepsis bundles(20).

Unavailability of adequate information regarding sepsis is currently one of the challenges as there are no hard or soft copy materials in the emergency. The fact that the hospital is an academic institution has helped the physicians and nurses to get information informally from discussions and teachings and they also try to read about sepsis by themselves.

Sepsis bundle implementation begins with identification of sepsis itself which depends on efficient triaging of patients. The Tikur Anbessa specialized hospital emergency triage uses the TEWS(Triage early warning score) score to triage all patients, and there is no sepsis specific screening tool in paper or electronic system used at the triage. The triage nurses are assisted by the senior residents in the triaging process not to miss septic or other critical patients. This is supported by a study as identifying and responding to sepsis is complex and needs multidisciplinary involvement (31). Early senior doctor involvement also facilitated timely decision making and improved bundle compliance(28). The emergency scenario may not allow for some of the screening tools but combination of some tools may help in fast response for decision making(19).Compliance to sepsis bundles is not enough if sepsis is not diagnosed early (20).

Poor and ineffective communication is a barrier for effective team work regarding sepsis which is still inadequate at Tikur Anbessa specialized hospital. This is more concerning outside the red zone where there is higher patient load and the number of nurses is fewer. Sometimes orders are

noticed by the nurses long after they are written by physicians and hence management starts delayed. This is because all patients are managed in order of their presentation. The other issue is that some nurses may feel they are 'being ordered' by physicians and not considered as part of team which has negative consequence on patient management.

There are no platforms prepared to compare the hospital's sepsis performance with that of other hospitals. But, as some participants mentioned, the emergency staff try to notice what other hospitals are doing regarding sepsis whenever they have a chance to visit other hospitals. This shows that there is an attitude of concern for sepsis and the outcome of sepsis patients.

There is currently no published guideline at national level regarding sepsis but it is under development. This shows that sepsis is getting the necessary attention by policy makers so that there will be improvement in that regard.

The communication between the emergency personnel with that of other departments is inadequate. This manifests for example as interruption of drug and material supply without an alternative solution from the pharmacy. Some patients' family may need to wait at the emergency pharmacy like other non-urgent cases to bring medications despite the urgency of sepsis and this is attributed to lack of communication between the emergency and pharmacy staff. The laboratory personnel do not know if samples sent for culture are before the initiation of antibiotic because laboratory order this is not clearly written and there is no discussion between the two departments on the matter. There has not been also any discussion with the laboratory persons on why there is no culture bottle at the emergency and why the results of culture do not come timely. This is not always the case where for disposition of patients there is good collaboration with ICU team, but the problem mostly arises due to unavailability of bed. Multidisciplinary approach should be performed to improve sepsis diagnosis and management(33).

There are no performance improvement measures specific for sepsis in the emergency but the laboratory has its regular quality assessment at the national as well as international level which helps it to improve from the previous performances. This definitely results in picking the hindrances to improvement of implementing sepsis bundles. There is a monthly report on all of the cases managed at the emergency with mortality reports but there are no other sepsis specific

measurements. For example there is no clear report on the timely identification and initiation of the bundle components for those who become critical after they are kept at the emergency. This could be due to gaps vital sign measurement timing and applying sepsis screening tools whenever patients become critical.

The efficacy of health care providers involved in sepsis care is individualized, but generally resident physicians and consultants are considered knowledgeable which is related to their involvement in academic activities directly. A gap is seen in some nurses and cleaners. The fact that there is poor knowledge results in lack of sense of urgency toward sepsis, poor handling of infectious waste which results in contamination of the environment.

The behavior of health care providers is a very important input in the implementation of sepsis bundles. For example having the sense of urgency for both sepsis and septic shock patients, handling of the equipment found in the emergency like the monitors, vital sign measurement tools and others. Of course this is influenced by previous trainings, identifying sepsis in the first place, and individual characteristic.

8. Limitation

The key limitation of the study include being a single center study which makes it difficult to generalize the finding to other settings.

9. Conclusion

There are different facilitators as well as barriers to implementation of sepsis bundles in the emergency identified in the research. The facilitators mentioned include being an academic environment for easy knowledge and skill sharing, readiness for positive change, focus being given to sepsis by higher officials. Some of the barriers include inadequate resources and budgeting, ineffective communication among health care providers inside or outside the emergency, lack of information, gaps in knowledge among health care providers and behavioral challenges to a positive culture by some care providers. Despite the fact that the research is done in single center; it can contribute to quality improvement projects related to sepsis management, creates a ground for future research and policy making.

10. Recommendation

Sepsis care requires a collaborative response of responsible health care providers which depends on different conditions. From the study findings; health care providers should practice effective communication, creating team spirit, systematic applications of guidelines to clinical setting. The hospital management should prepare regular trainings, performance improvement initiatives and measurements involve key stake holders, create a platform involving other hospitals to show improvements in sepsis care and experience sharing. The higher health officials at Minstry of health (MOH) should enhance sepsis guideline development to assist front line health care providers.

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Annexes

Annex 1

Assurance of the principal invertigator

I, the undersigned, agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide a timely progress report to my advisor and seek the necessary advice and approval from my primary advisors during the research. I will communicate timely to my advisors all stakeholders involved in the study, including any funding source for this research.

Name of the student: _____

Signature: _____

Date: _____

Approval of the primary Advisor Name of the primary advisor:

_____

Signature: _____

Date: _____

Annex 2: Information sheet and consent form

Research Project: The facilitators and barriers of implementation of sepsis bundles in a a government teaching hospital

Name of Principal Investigator: Dr Eden Solomon

Introduction : This information sheet and consent form is prepared by the investigator whose aim is to study the facilitators and barriers of implementation of sepsis bundles in the Tikur Anbessa Specialized hospital of Addis Ababa, Ethiopia. The investigator is an emergency medicine and critical care resident from Addis Ababa University.

Purpose: The purpose of the study is to identify the facilitators and barriers of implementation of sepsis bundles in government teaching hospital.

Procedures: you are kindly invited to take part in our research because we believe you can provide the necessary information for the research. Participation in the study is voluntary. If you are willing to participate in our project, you need to understand and sign the consent form. Then, you will be asked to give your response by the data collectors. All the responses given by the participants and the results obtained will be kept anonymous and confidential. No one outside the research team will have access to your responses.

Risk and/or Discomfort: There is no risk that this research will pose to its participants. Benefits: This study will have paramount importance. It will generate a hypothesis for further research done in this area. Further, the result will be communicated to the respective stakeholders, including the Federal Ministry of Health, for reviewing its guideline per the physicians' perception.

Incentives: There is no incentive associated with the study

Confidentiality and Anonymity: The information we will collect from this research project will be confidential. Information about you that will be collected from the survey will be stored in a file, which will not have your name on it, and it will not be revealed to anyone except the principal investigator.

Right to Refuse or withdraw: you have the full right to refuse to participate in this research (you can choose not to respond to some or all of the questions). If you do not wish to participate, this will not affect you. You also have the full right to withdraw from this study without losing your rights as a site resident.

Persons to contact for further information: If you have any questions, you can contact the principal investigator at the following address:

Name: Dr. Eden Solomon
Tel: +251911 346761
Email: edensolomonlammii@gmail.com

If you agree to participate in this study, I appreciate your truthfulness. And after having this consent form read to you, please put a sign below to show if you are willing to participate (No need to write your name). Are you willing to participate in this study? Yes [ ] No [ ]

Annex 3: Interview Questions (English)

1. Tell me about your self and your role in the emergency?
2. How do you understand sepsis bundles?
3. OUTER SETTING
    A. What do you know about the availability of the resources for carrying out sepsis bundles in the emergency?
    B. How is the competitive pressure with other institutions regarding the implementation of sepsis bundles?
    C. What policy or direction is there from the government regarding the implementation of sepsis bundles?
    D. How is the networking in the emergency with other departments in the institution like laboratory, pharmacy in the realization or implementation of sepsis bundles?
4. INNER SETTING
    A. How is the network amongst emergency care providers (nurses, residents, coordinator nurses, interns) to facilitate the implementation of sepsis bundles for these patients?
    B. How is the availability of information about sepsis bundles whenever there is a need of reference in the working area ?(Information in whatever form)
5. INDIVIDUAL CHARACTERISTICS

    How efficient are the emergency health care providers in applying sepsis bundles during their encounter with sepsis patients? (Knowledge as well as skill?)
6. PROCESS
    A. How is the team work of the staff to apply sepsis bundles in the management of sepsis/septic shock patients?
    B. What do you think is challenge regarding the practical implementation of sepsis bundles in the emergency set up?
    C. What is being done to reflect and evaluate the outcome of sepsis/ septic shock patients after implementing sepsis bundles?
7. What do you recommend about conditions that will help in full implementation of sepsis bundles in the emergency?

Annex4 Amharic translated questionnaire

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Annex 5
Declaration

I, the undersigned, agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide a timely progress report to my advisor and seek the necessary advice and approval from my primary advisors during the research. I will communicate timely to my advisors all stakeholders involved in the study, including any funding source for this research.
Name of the student: _
Signature: ___

Date: _

Approval of the primary Advisor Name of the primary advisor:

_____

Signature: ___

Date: _